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HL7 Version 3 – Models & Terminology

(Being balloted now – www.hl7.org/home)

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Topics requested

- Rationale behind HL7's development of RIM & USAM
- Methods & processes used to develop & maintain these models
- How does RIM include, coordinate and reference clinical terminologies
- Role of the information models in generating Version 3 messages
- Projected time-frame for Version 3 s\availability

Outline of presentation

- **Brief review of HL7**
- **Genesis of Version 3**
 - a model-based standard
- **HL7 Reference Information Model (RIM)**
 - its development and maintenance
- **Unified Service Action Model (USAM)**
 - The foundation of the current RIM
- **From model to messages**
 - the design relations and “tooling” to support them
- **Version 3 and clinical terminologies**
 - an essential marriage
- **Status of Version 3 Message standards**

Agenda

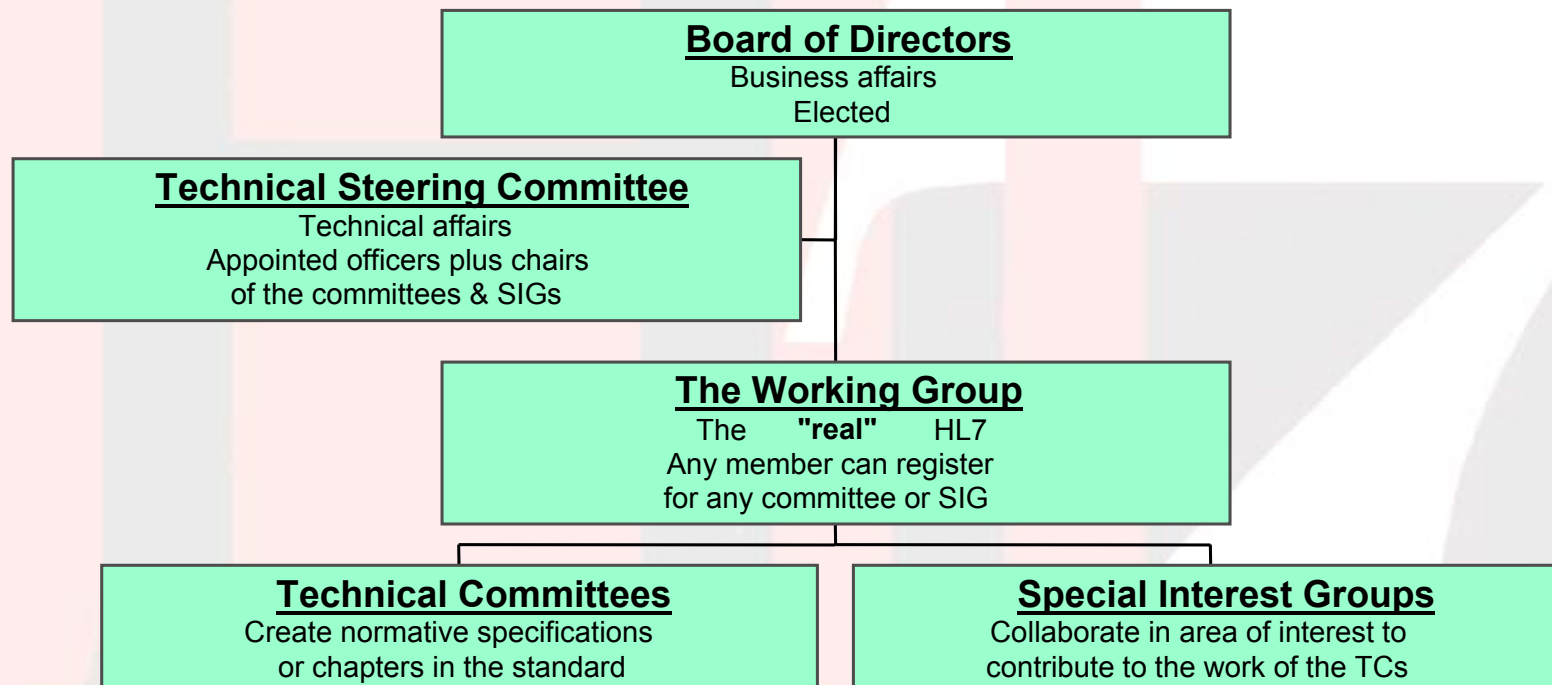
- **Brief review of HL7**
- **Genesis of Version 3**
- **HL7 Reference Information Model (RIM)**
- **Unified Service Action Model (USAM)**
- **From model to messages**
- **Version 3 and clinical terminologies**
- **Status of Version 3 Message standards**

Who is HL7?

- 14-year-old, not-for-profit organization
- ANSI-accredited standards developer since 1994
- HL7 Working Group meets for one-week at a time, three times each year
- Over 500 organizational members
- About 2200 total members
- Up to 500 attend the Working Group Meetings
- International affiliates in 17 countries
- Version 2 Standards are widely used in US and being rapidly adopted world-wide

How is HL7 organized?

- Collaborative volunteer organization
- Paid staff limited to the secretariat
- Primary funding is membership dues



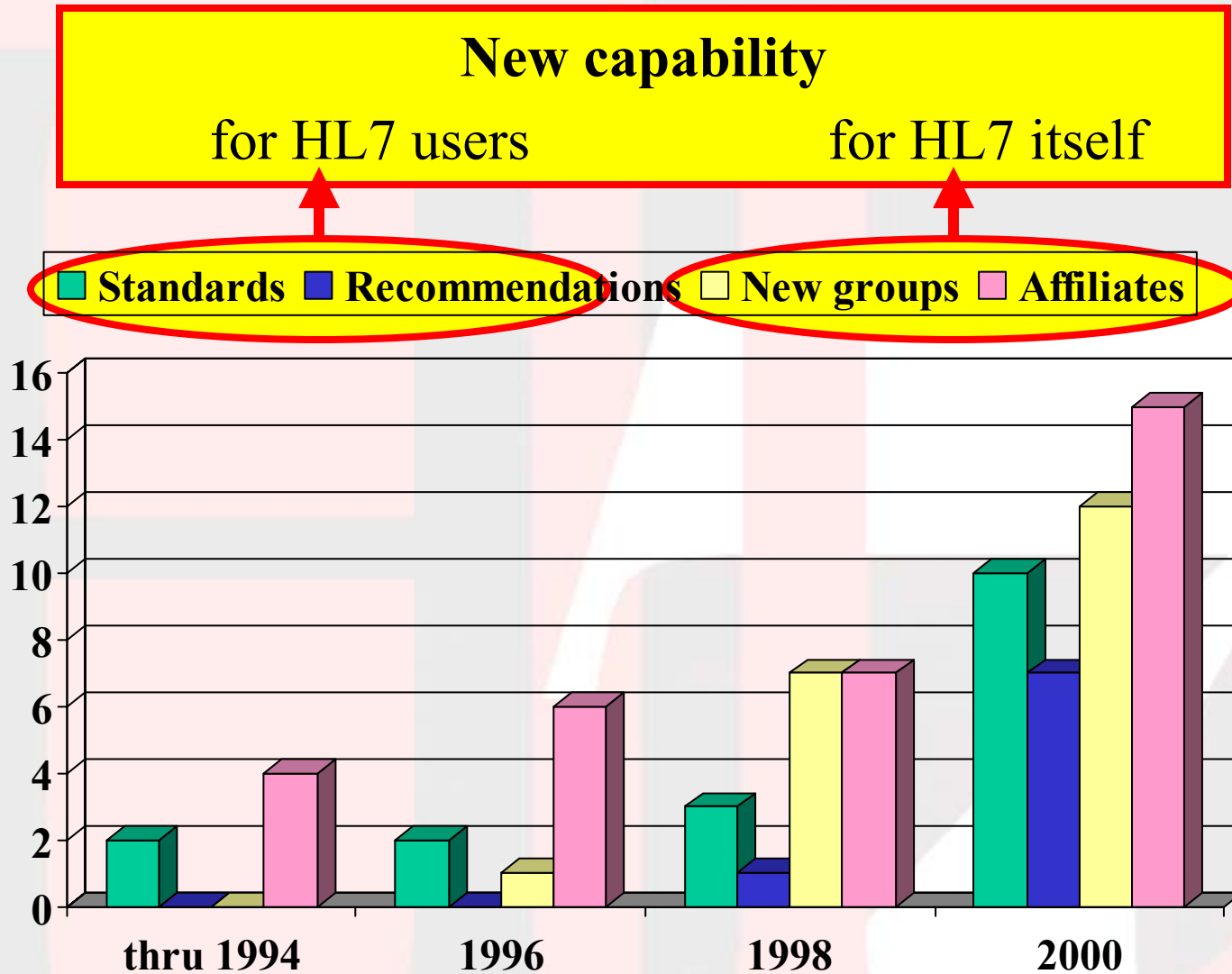
The Working Group

- Draws equally from providers, software vendors, and consultants
- Group sets aside their individual interests, rolls up their sleeves and collaborate to get the tough work done
- **HARD WORK** - five, 12-hour days, three times a year plus active electronic collaboration in between

What has HL7 produced?

- Founded in 1987
- Produced Version 1.0 and 2.0 in '87 and '88
- Approved HL7 message standards -
 - 2.1, 2.2, 2.3, 2.3.1 and 2.4 in '90, '94, '97, '99 and '00
- Approved CCOW standards
 - 1.0, 1.1, 1.2, 1.3 in '99, '00 and '01
- Approved Arden Syntax standard in '99
- Approved XML-based Clinical Document Architecture standard in '00
- Accredited as an SDO by ANSI in 1994
 - All HL7 approvals since '94 are “American National Standards”
- Published implementation recommendations for:
 - Object broker interfacing '98
 - Secure messaging via e-mail '99
 - HIPAA Claims attachments '99
 - XML encoding of Version 2 '00

Impact – Who we are & What we do



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Interoperability & Innovation

HL7's **mission** is clinical interoperability

“To provide standards for the exchange, management and integration of data that supports clinical patient care and the management, delivery and evaluation of healthcare services.”

Source: HL7 Mission statement (1997)

HL7's **strategy** is innovation – both by ourselves and by our users

Interoperability & Innovation

- Main Entry: **in•ter•op•er•a•bil•i•ty**

Function: *noun*

Date: 1977

: ability of a system (as a weapons system) to use the parts or equipment of another system

Source: Merriam-Webster web site

- **interoperability**

: ability of two or more systems or components to exchange information and to use the information that has been exchanged.

Source: IEEE Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries, IEEE, 1990]

Functional
interoperability

Semantic
interoperability

Interoperability & Innovation

- Main Entry: **in·no·va·tion**

Function: *noun*

Date: 15th century

1 : the introduction of something new

2 : a new idea, method, or device : novelty

Source: Merriam-Webster web site

Why Version 3?

- Even as the first Version 2 standards were being accepted and implemented, HL7 began to seek a *better* way to develop standards
- Initial strategy was a quick-design approach to meet immediate needs in the health care IT community
- But it is an *ad hoc* method that is difficult to coordinate and control
- Hence, Version 3

How “better”?

- A conceptual foundation in a single, common reference information model to be used across HL7
- A strong semantic foundation in explicitly defined concept domains drawn from the best terminologies
- An abstract design methodology that technology-neutral – able to be used with whatever is the technology de jour
- Maintain semantic content in a repository (database) to assure a single source, and enable development of support tooling

The “essence” of Version 3

- Apply the ‘best practices’ of software development to developing standards – a model-based methodology
- Predicate all designs on two semantic foundations – a reference information model and a complete, carefully-selected set of terminology domains
- Require all Version 3 standards to draw from these two common resources
- Use software-engineering style tools to support the process.

Version 3 Timetable

- 1996 – Introduced concepts to Technical Leadership
- 1997 – Presented first methodology and draft RIM to Working Group
- 1997 – Created Vocabulary Technical Committee
- 1998 – Introduced complete methodology
- 1999 – Unified Service Action Model (USAM) became part of RIM (11/99)
- 2000 – Initiated Acceleration Project (5/00)
- 2001 – First “non-draft” RIM, version 1.0 (1/01)
- 2001 – First committee submissions of storyboards, interactions and message designs (7/01)
- 2001 – Published 1st comprehensive ballot (8/09)

Lessons from the time-table

- Formal processes have a long gestation period for learning and adapting
- Development of common model is not a “free” process
- Reaching agreement on a single model is both exciting and – **very** difficult
- Once the pieces are in place, actual standards design is amazingly quick

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Reference Information Model (RIM)

- Initial model
 - developed from submissions by five member organizations
 - was a “traditional” conceptual information model using object-based, UML modeling constructs
- All subsequent releases have evolved as a result of the HL7 “Harmonization Process”
- Harmonization is used for both the RIM and the HL7 Vocabulary Domains

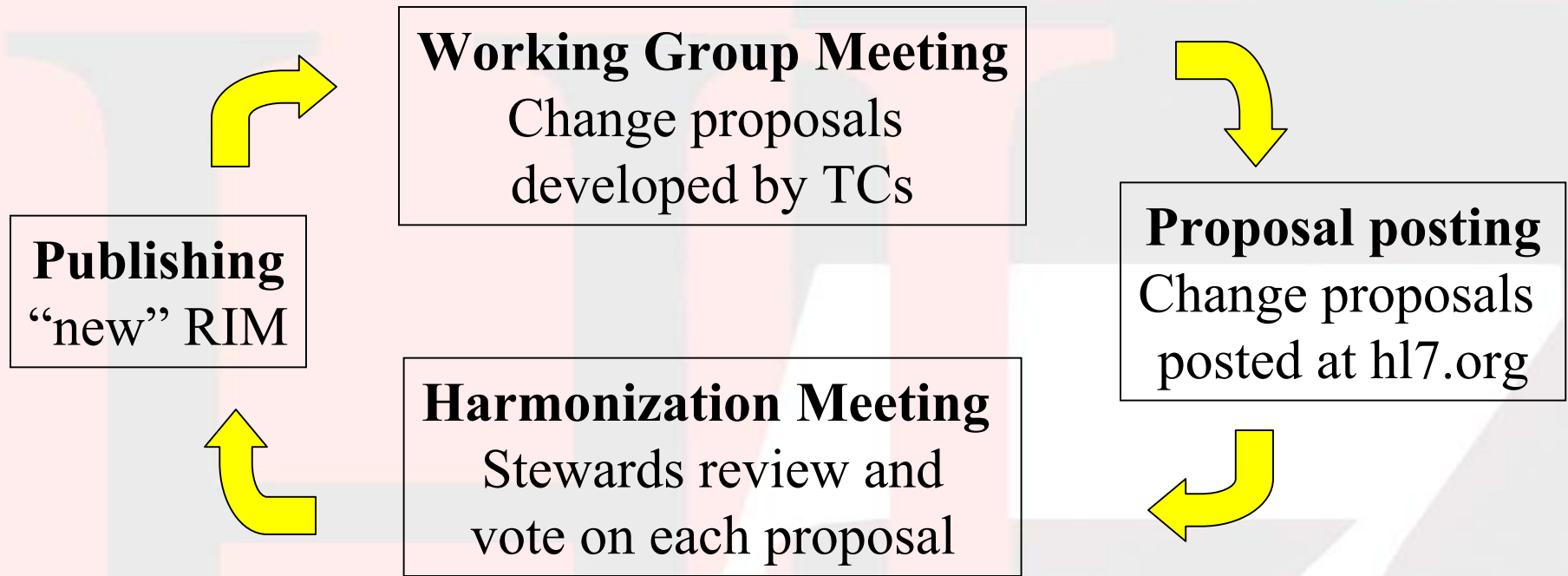
The Reference Information Model (RIM)

- Expresses the information content for the collective work of the HL7 Working Group in UML notation.
- A coherent, shared information model that is the source for the data content of all HL7 messages.
- Maintained by a collaborative, consensus building process involving all Technical Committees and Special Interest Groups.
- RIM change proposals are debated, enhanced, and reconciled by technical committee representatives and applied to the RIM during the model harmonization process

Model Harmonization

- The RIM and Vocabulary domains are developed by the domain experts in the various HL7 Technical Committees
- HL7 has recruited modeling and vocabulary facilitators to support each committee
- Change proposals from the individual committees are reviewed and ‘harmonized’ during HL7-funded interim meetings that occur between each pair of Working Group meetings
- Thus an evolved (new) RIM is provided as the starting point for each Working Group Meeting

Harmonization cycle



- The key to successful harmonization is the combination of an approval vote by ones peers coupled with the ability to amend a proposal during harmonization

RIM Statistics by Version

Year	Version	Concepts			Relationships		
		Subj Areas	Classes	Attributes	Assoc	Gen	Comp
1997	RIM 0.80	24	126	861	138	30	14
1998	RIM 0.82	40	123	890	179	33	9
	RIM 0.84	39	126	900	157	25	9
	RIM 0.86	41	120	842	154	41	9
1999	RIM 0.88	41	120	821	155	41	5
	RIM 0.90	41	119	782	160	41	5
	RIM 0.92	41	120	712	167	41	3
2000	RIM 0.94	37	114	536	159	27	3
	RIM 0.96	38	110	532	167	30	2
	RIM 0.99	38	110	494	100	54	0
2001	RIM 1.0	38	111	466	51	77	1
	RIM 1.02	20	104	306	37	77	1
	RIM 1.10	8	81	307	25	65	1
	RIM 1.10 (less Infrastructure)	5	46	207	9	46	1

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Unified Service Action Model

- Arose in 1998 as result of collaboration between Orders/Observations and Patient Care Technical Committees of HL7
- As name implies, sought to unify the HL7 view of what happens when clinical services are rendered and clinical actions undertaken
- Model refined and adopted as part of the RIM in November 1999
- Between 11/99 and July, 2001, the same concepts have been applied to the whole of the RIM, achieving a single, consistent set of abstractions.

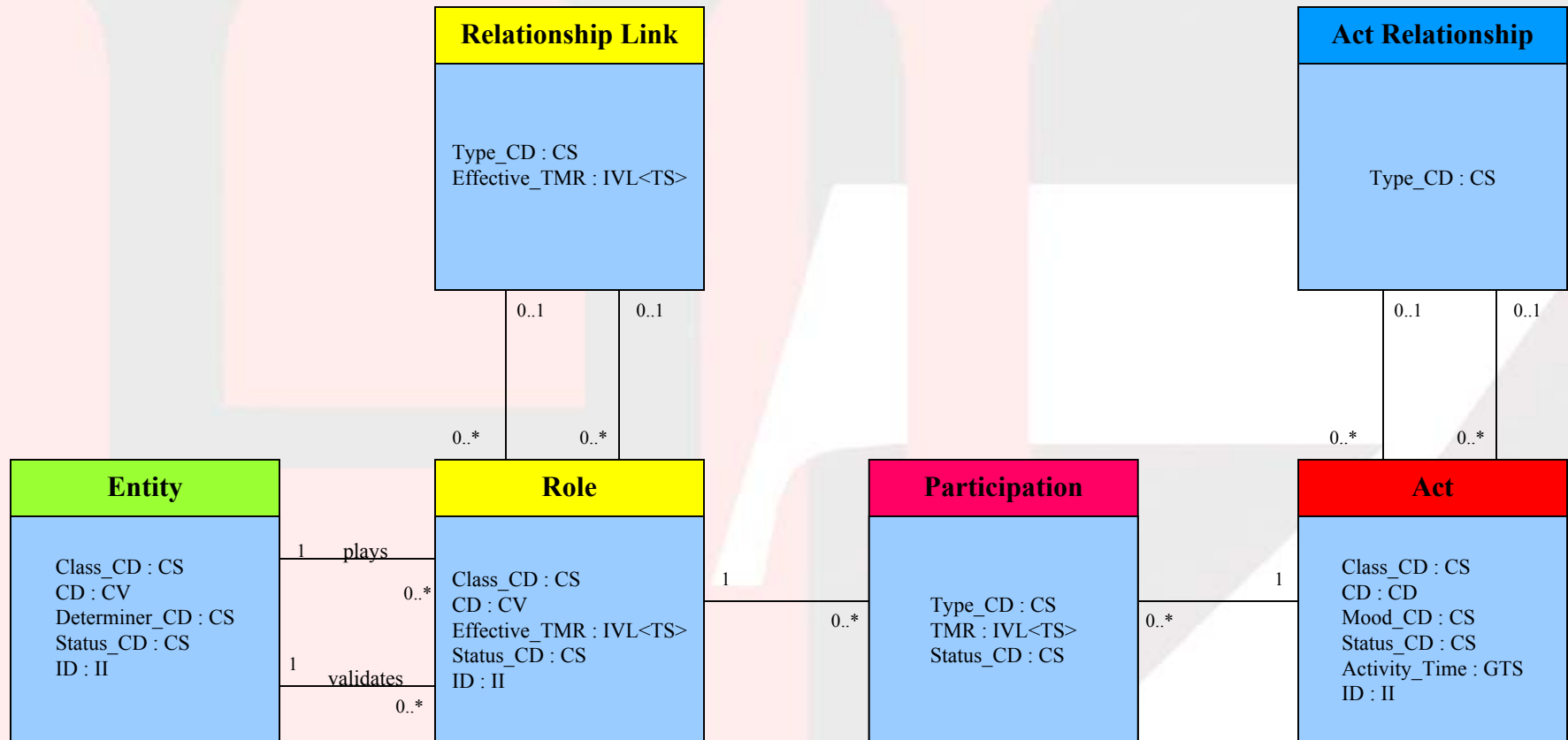
Core concepts of USAM

- The “Act” class and its specializations represent every action of interest in health care.
- Specifically –
“an intentional action in the business domain of HL7. Healthcare (and any profession or business) is constituted of intentional actions. An instance is a record of an act. Acts definitions (master files), orders, plans, and performance records (events) are all represented by an instance of Act.”

Core concepts of RIM/USAM (cont)

- Every happening is an **Act**
 - Procedures, observations, medications, supply, registration, etc.
- Acts are related through an **Act_relationship**
 - composition, preconditions, revisions, support, etc.
- **Participation** defines the context for an Act
 - author, performer, subject, location, etc.
- The participants are **Roles**
 - patient, provider, practitioner, specimen, specimen, etc.
- Roles are played by **Entities**
 - persons, organizations, material, places, devices, etc.

RIM Core Classes & Attributes



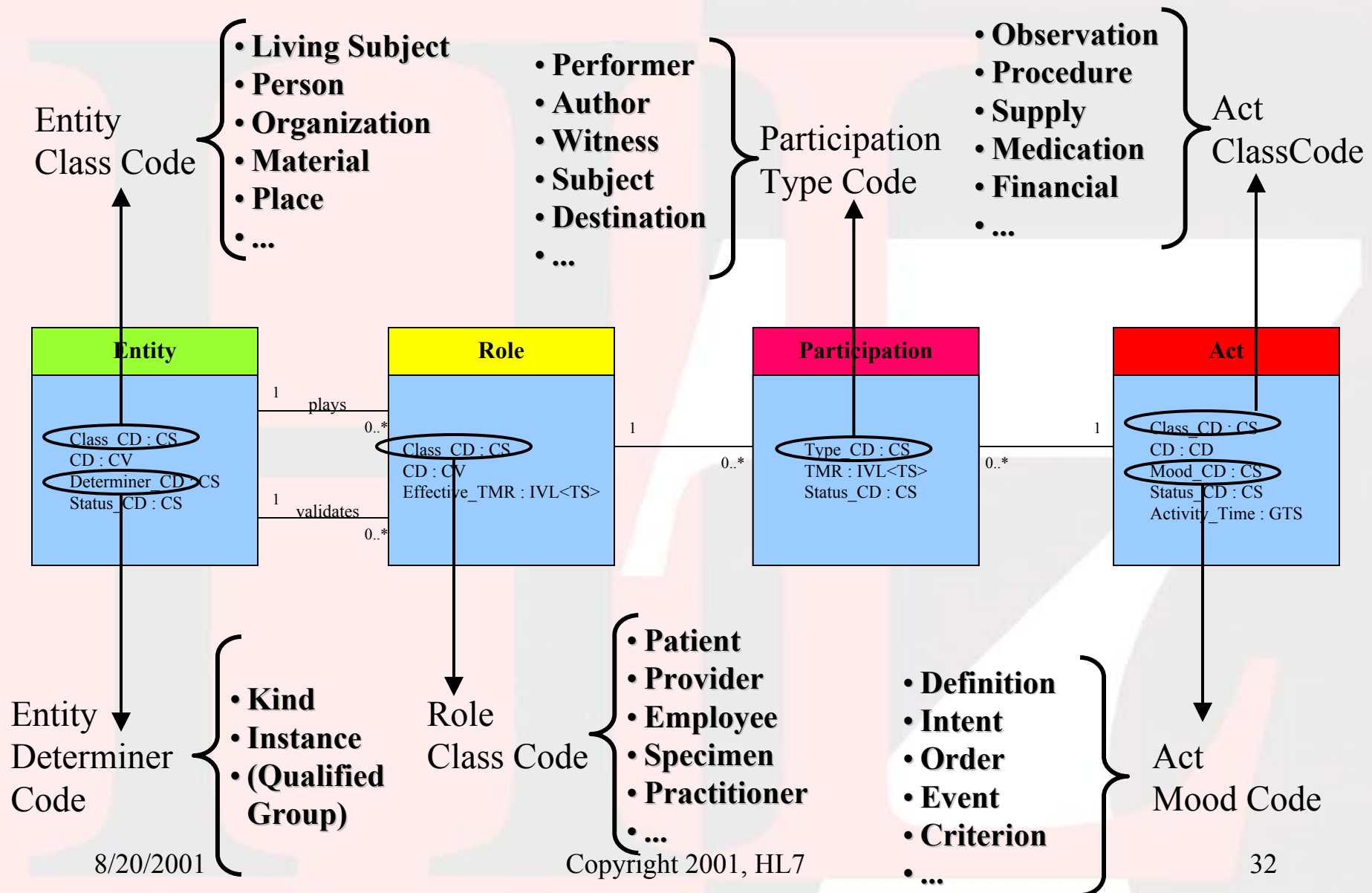
Six kinds of attributes:

type_cd(class_cd), cd, time, mood(determiner), status, id

How does HL7 manage this abstraction?

- Pre-USAM, each model element had a visible (physical) class or association to represent it
- Post-USAM, we only include a class when it adds new attributes and associations
- For the rest, we use coded “structural” attributes – ‘class’ or ‘type’ codes
- Why structural? Because they represent in terminology model concepts that would previously have been part of the model structure.

RIM Core Attribute Value Sets



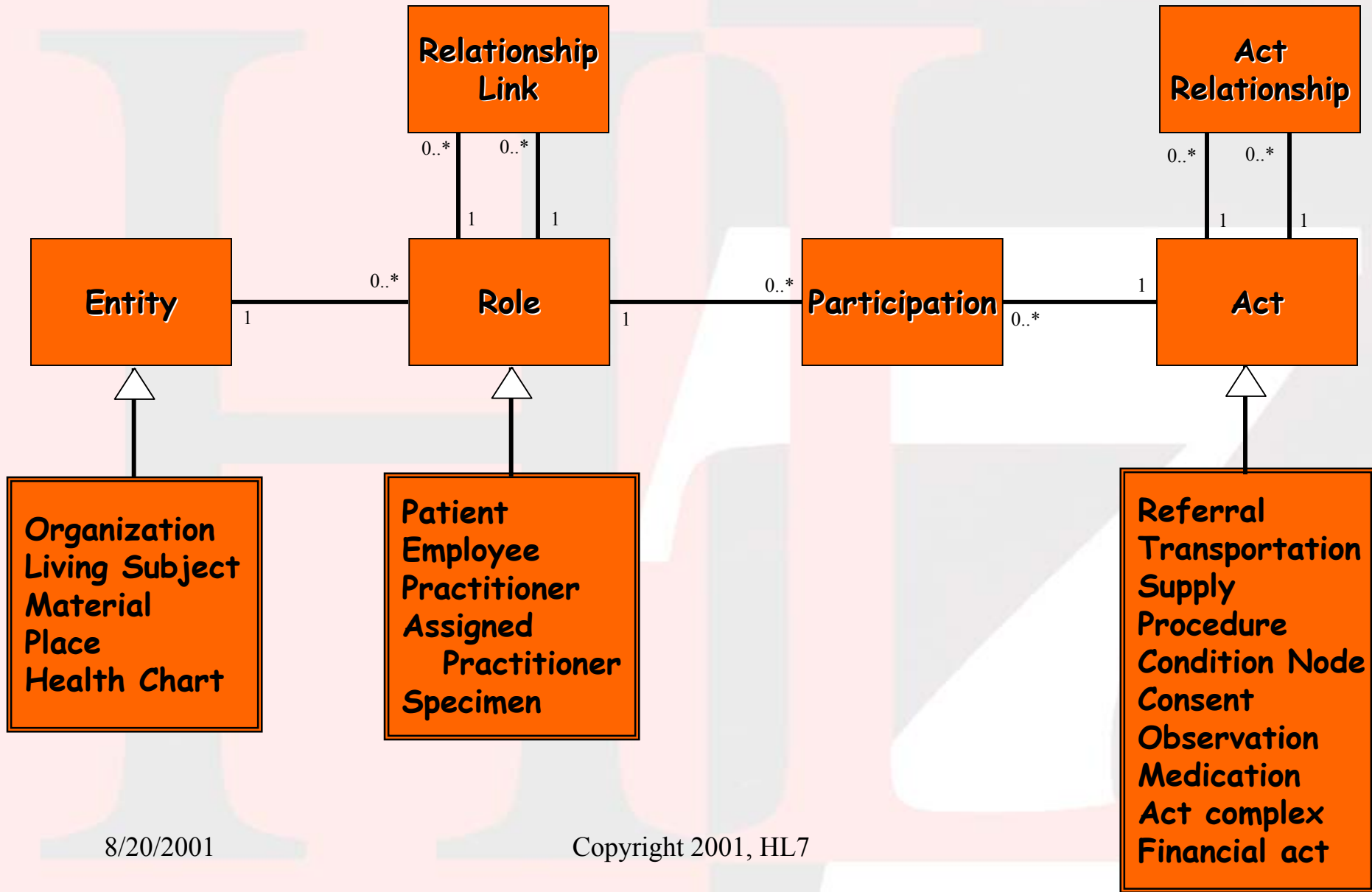
Is “Act” sufficient?

- How can a single act class represent all of the elements of clinical action – their definition, request, order, report?
- Answer: the Act “**mood**” code –
“Webster's dictionary defines mood as a "distinction of form [...] of a verb to express whether the action or state it denotes is conceived as fact or in some other manner (as command, possibility, or wish)". This definition of mood can be directly applied to the USAM model, where the action (in natural language) may be conceived as an event that happened (fact), an ordered service (command), a possible service (master), and a goal (wish) of health care.”

Principle Act ‘moods’

- definition (DEF) – Definition of an act, formerly a “master file”
- intent (INT) – an intention to plan or perform an act
- order (ORD) – an order for a service from an order “placer” to an order “filler”
- event (EVN) – an act that actually happens, includes the documentation (report) of the event
- **Critical concept** – “Mood” is not a status code. Each instance of the Act class may have one and only one value for ‘mood’
- Thus, an act in “order” mood that orders an act in definition mood and results in an Act in ‘event’ mood are three different acts, related through the act relationship.

RIM Core Classes



Definitions

Act - an intentional action in the business domain of HL7. Healthcare (and any profession or business) is constituted of intentional actions. An instance is a record of an act. Acts definitions (master files), orders, plans, and performance records (events) are all represented by an instance of Act.

Entity - physical thing or organization and grouping of physical things. A physical thing is anything that has extent in space, mass. **Excludes information structures**, electronic medical records, messages, data structures, etc.

Role – defines the competency of an Entity. An Entity, in a particular Role, can participate in an Act or can be related to another Entity in a particular Role. The Role defines the competency of an Entity irrespective of any Act, as opposed to Participation which is limited to the scope of an Act.

Each role is “played by” one Entity and is usually “scoped” by another. Thus the Role of “patient” is played by (usually) a person and scoped by the provider from whom the patient will receive services. Similarly, an Employee role is scoped by the employer.

Definitions (continued)

Participation -- Participation defines how an Entity, in a particular Role, functions during the scope of an Act. Participation is limited to the scope of the Act, as opposed to Role, which defines the competency of an Entity irrespective of any Act. **Role signifies competence while participation signifies performance.**

Relationship Link – Is similar to an Act relationship in that it binds together two entities in roles and their relationship with their respective scoping entities. The primary forms of this link connote a chain of authority (the source role provides direct or indirect authority to the target) and composition (the target is part of the source) .

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From abstraction to ‘concrete’ concepts

- How can this “skinny” RIM and its codes represent the large, sophisticated sets of concepts that must be communicated to support modern health care?
- Answer: The RIM is the starting point, the source or pattern, from which specific models are constructed to define a particular set of messages.
- The messages are based on a RIM-derivative known in HL7-ese as the Refined Message Information Model, or RMIM,
- The RMIM is constructed using the RIM pattern and definitions, but is specific as to which type of act, participation and role is intended.

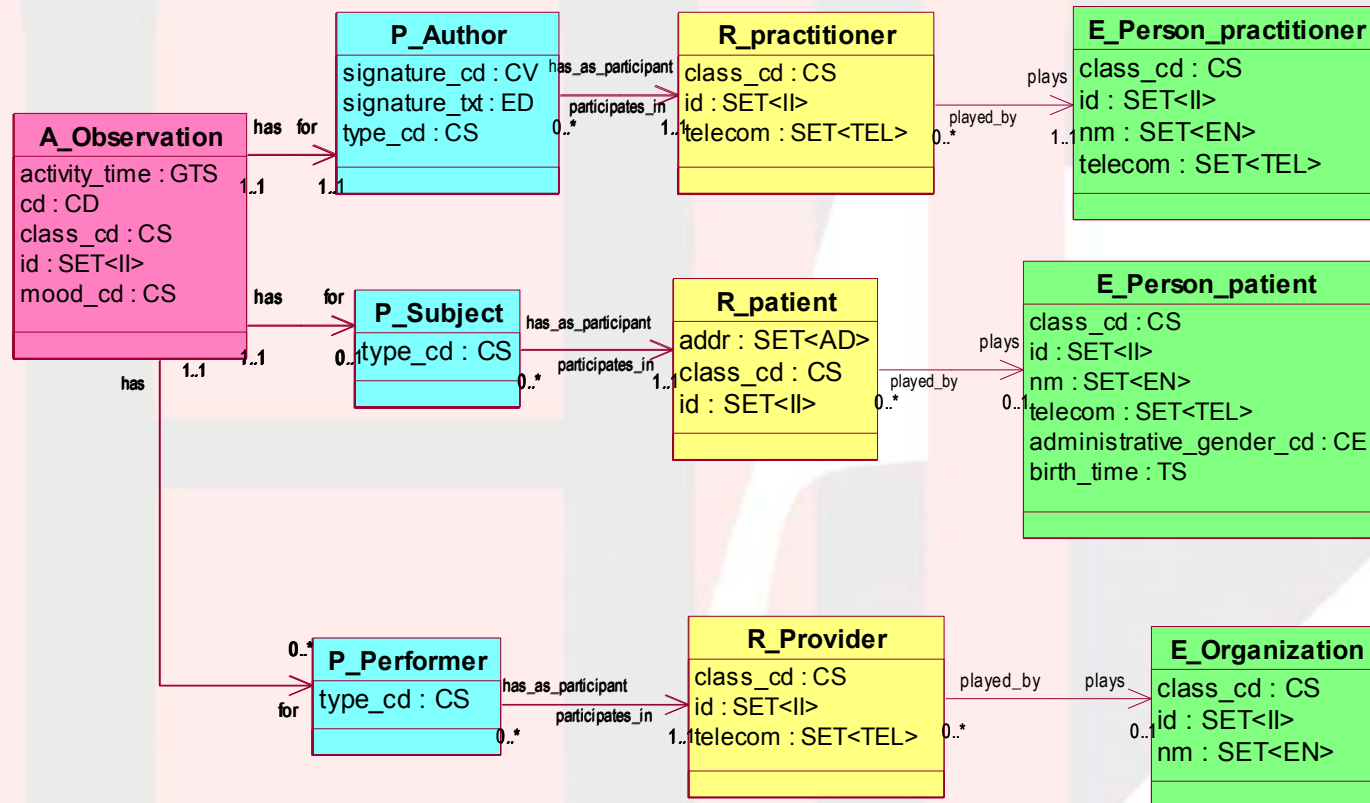
RMIM construction

- Construction of an RMIM is the first, and most critical, step in the message design process
- The RMIM is built from “constrained clones” of the base classes that are in the RIM
- These clones
 - contain only attributes found in the RIM
 - have specific, usually singular values for the class or type codes
 - constrain other coded attribute domains as appropriate to the type being defined
 - limit repeatability and optionality of the associations and attributes
- Multiple clones of a single RIM class are commonly found in RMIM designs

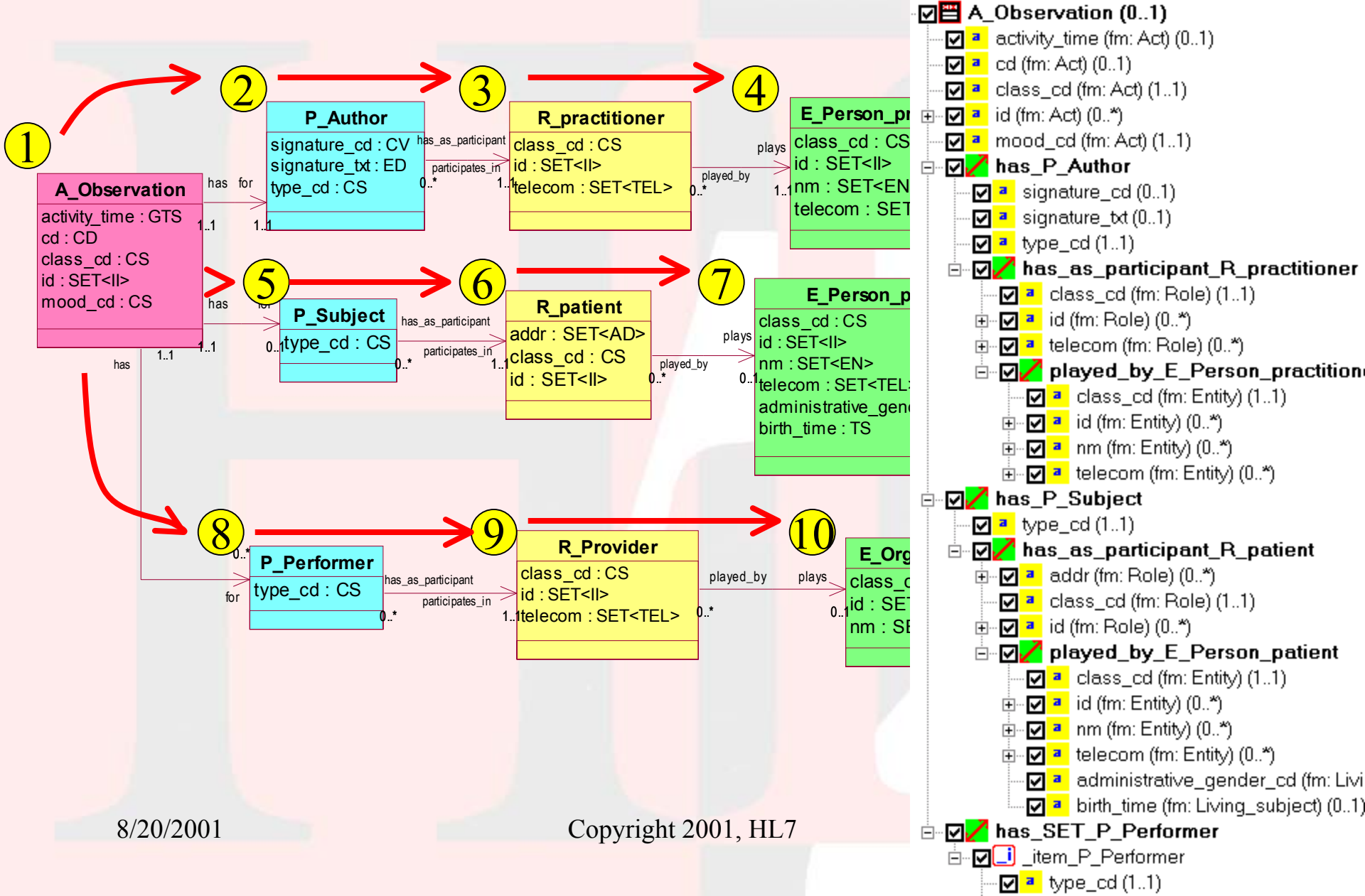
Simple example

- A clone of Act is created in “order” mood, with “observation” class code, and a specific domain of observation types codes (code attribute) drawn from LOINC.
- Clones of the Participation class identify the “author”, “subject” and “performer” through the type code
- Clones of Role are created as the participants that are “practitioner”, “patient” and “provider”, respectively
- Clones of Entity – two as “person”, one as “organization” are created to play these roles.
- In all ten different clones are created from just four RIM “backbone” classes.

Example as a model



Message structure from RMIM



Tooling for Version 3 Methodology

- HL7 and individual members have provided a variety of software tools to support this process
 - Data base repository to hold RIM, Vocabulary, all publication and design documentation
 - Software to maintain and publish RIM & vocabulary
 - Publication data base to facilitate entry of textual and graphical documentation
 - Browsers to review all repository content
 - Design tools that permit interactive RMIM design in graphic program and subsequent import to the repository
 - Design tools to document the constraints imposed during message design
 - Extraction tools to express repository content in XML
 - Publication tools to convert XML to HTML and PDF formats

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Terminologies & the RIM in V3

- From the outset, one goal of the Version 3 process has been that no coded attribute should be included in a message design unless there is a specific vocabulary domain defined to constrain the values for that attribute to a set that is appropriate for the particular message
- Resulted in two, parallel efforts
 - Definition of vocabulary domains to support messages
 - Rich capability in the HL7 data types to preserve the semantic integrity of the terminologies used

Concept descriptor data type (CD)

Table 10: Summary of Concept Descriptor (CD)

Name	Description
code	A string containing the value of the code (e.g., "F150")
displayName	A string containing a short, human-readable description of the code. ("Ford F150 Full-size Pickup Truck")
codeSystem	An Object Identifier (OID) that uniquely identifies the code system to which the code belongs (e.g., "106.75.314.67.89.24," where this uniquely identifies Ford Motor Company's set of model numbers).
codeSystemName	A string containing a short, human-readable description of the code system (e.g., "Ford Car and Truck Models ").
codeSystemVersion	A string qualifying the version of the code system (e.g., "Model Year 2001").
originalText	This is the text, phrase, etc., that is the basis for the coding. (e.g., "The new truck purchased for hospital facility maintenance was a Ford model F150 ...").
modifier	Some code systems permit modifiers, additional codes that refine the meaning represented by the primary code. HL7 Version 3 accommodates a list of modifiers. Continuing with our truck example, the list of modifiers "Body-ECAB, Eng-V8, EM-CE" modify "F150" to designate that the truck has an extended cab, V8 engine, and California Emissions package. "Body-," "Eng-," and "EM" designate the roles (body, engine, emissions) represented by the codes "ECAB," "V8," and "CE."
translation	Quite often in an interfaced environment, codes need to be translated into one or more other coding systems. In our example, the California DMV may have their own code

Restricted data types derived from CD

Table 11: Summary of Coded Simple Value (CS)

Name	Type	Status
code	SI	mandatory
displayName	SI	optional

Table 12: Summary of Coded Value (CV)

Name	Type	Status
code	SI	mandatory
displayName	SI	optional
codeSystem	OID	mandatory
codeSystemName	SI	optional
codeSystemVersion	SI	optional
originalText	SI	optional

Table 13: Summary of Coded with Equivalents (CE)

Name	Type	Status
code	SI	mandatory
displayName	SI	optional
codeSystem	OID	mandatory
codeSystemName	SI	optional
codeSystemVersion	SI	optional
originalText	SI	optional
translation	SET < CV >	optional

Vocabulary Domains in V3

- Currently, vocabulary definitions are provided for
 - 108 tables
 - containing 5,323 concepts
 - grouped into 639 values sets or domains
- Vocabulary Committee actively seeking to define additional domains on external terminologies of clinical concepts
- Vocabulary committee premise – do not develop a code set internally where a comprehensive, well-maintained terminology is available externally at a reasonable cost

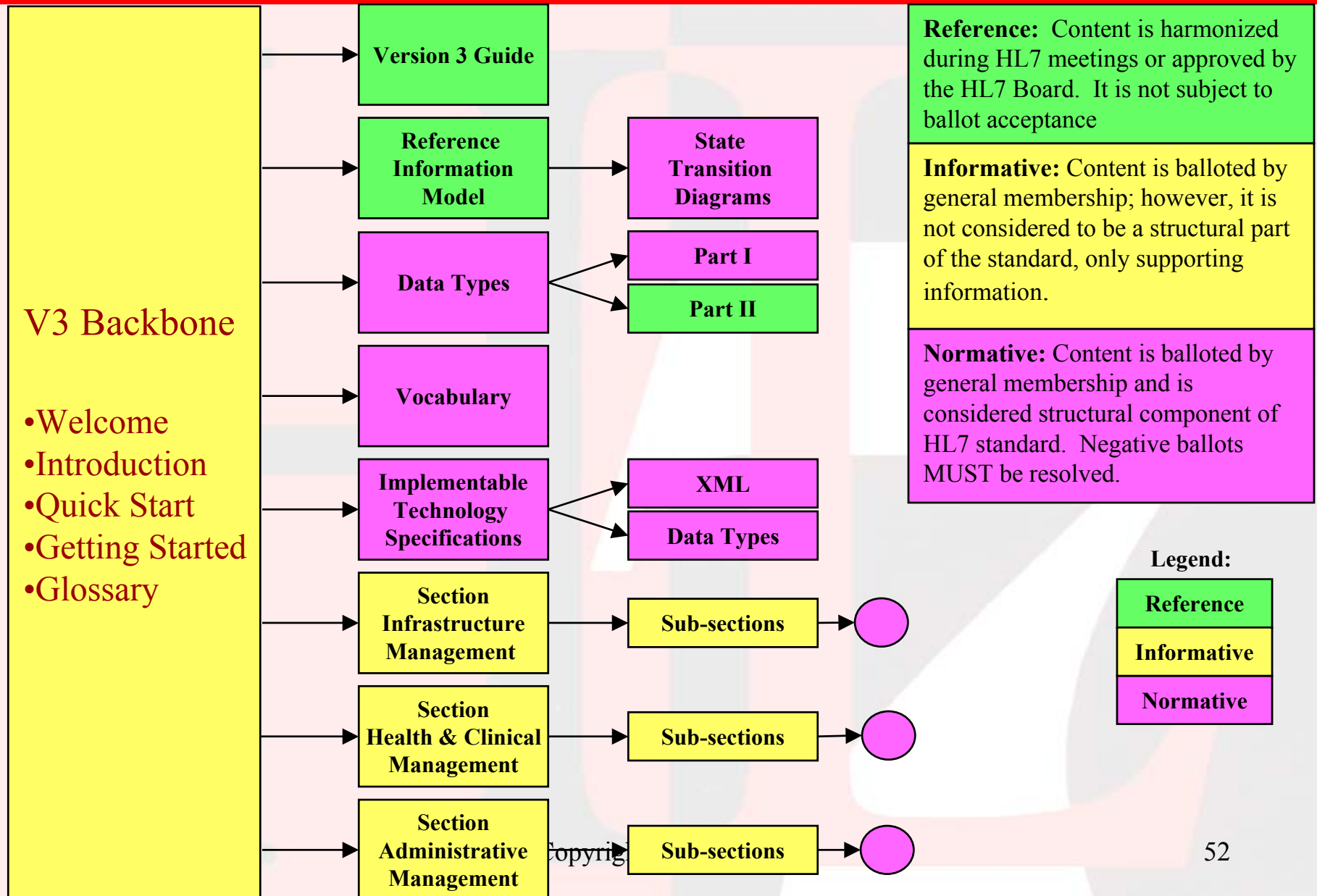
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Initial Version 3 Ballot Package

- Developed between May and July, 2001
- Five domain committees participated
 - Orders/Observations
 - Patient Administration/Finance
 - Medical Records Management
 - Control/Query
 - Scheduling
- Contains
 - over 275 specific message types
 - supporting over 250 trigger events
 - used in over 360 specified interactions
 - involving 190 application roles
 - using over 30 “common” message element types
 - Supported by over 150 story-boards

HL7 3.0 Structure



Specific domains in V3 Ballot

- Control domain
 - Message control
 - Master files
- Finance
 - Accounting & billing
 - Claims & reimbursement
- Practice
 - Laboratory
 - Pharmacy
- Practice administration
 - Patient administration
 - Scheduling
- Medical records management
- Query
 - MPI query

Version 3 Time-line

- August 9, 2001 – committee-level ballot opened
- September 8, 2001 – ballot closes
- October 1-5, 2001 – Fall Meeting – ballot reconciliation
- December 2001 – second-round ballot at either committee or membership level
- January 7-11, 2002 – Reconcile 2nd ballot
- March-April, 2002 – 3rd Ballot, if required
- April 29-May 3, 2002 – 3rd ballot reconciliation

Conclusion

HL7 recognizes that proper communication of clinical concepts and the context in which those concepts are determined and used can only be achieved through careful definition of the context through a reference information model and the content through expressive, coordinated, broadly conceived terminologies. We believe the HL7 RIM and Vocabulary Domains, coupled with the strong, currently-available terminologies will accomplish this, and that the initial set of Version 3 Messages, now being balloted, will demonstrate this synergy unequivocally.

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Thank you!

Questions?